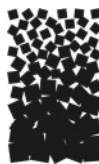# Species Composition (SC)
Sampling Method

EXECUTIVE SUMMARY

The FIREMON Species Composition (SC) method is used to provide ocular estimates of cover and height measurements for plant species on a macroplot. The SC method provides plant species composition and cover estimates to describe a stand or plant community and can be used to document changes over time. It is suited for a wide variety of vegetation types and is especially useful in plant communities with tall shrubs or trees. The method is relatively fast and efficient to conduct in the field and facilitates sampling many sites over large areas using few examiners. The SC method does not quantify the variability within a plot and cannot be used to detect statistically significant changes over time.

INTRODUCTION

The Species Composition (SC) method is designed to provide plant species composition, and cover and height estimates to describe the plant community found on the FIREMON plot. This method uses a circular macroplot to record plant species characteristics. Cover, height, and optional user specific attributes are recorded for each plant species or ground cover within the macroplot. Plant height is measured in feet or meters.

This method is primarily used when the user wants to acquire inventory data over large areas using few examiners. The SC method is useful for documenting important changes in plant species cover and composition over time. However, this method is not designed to monitor statistically significant changes in vegetation over time due to the subjective nature of the cover estimations. The SC sampling method primarily addresses individual plant species cover and height for vascular and non-vascular plants, by size class.

Cover is an important vegetation attribute which is used to determine the relative influence of each species on a plant community. Cover is a commonly measured attribute of plant community composition because small, abundant species and large, rare species have comparable cover values. In FIREMON we record foliar cover as the vertical projection of the foliage and supporting parts onto the ground. Therefore, total cover on a plot can exceed 100 percent due to overlapping layers in the canopy. When cover is summed by size class, the total cover can equal more than 100 percent for a plant species due to overlap in the canopy between the different size classes.

Ocular estimates of cover are usually based on cover classes. The two most common are Daubenmire (1959) and Braun-Blanquet (1965). The range of cover values, 0 to 100 percent, are divided into classes, and each class is assigned a rating or number. In broadly defined cover classes, there is little chance for consistent human error in assigning the cover class (Daubenmire, 1959). The lowest cover classes are sometimes split into finer units (Jensen and others 1994, Bailey and Poulton 1968), since many species fall into the lowest cover classes. These systems are more sensitive to species with low cover. A finer breakdown of scale toward the lower scale values allows better estimation of less abundant species. In FIREMON we use a cover class system which splits the lowest classes into finer units. The midpoint of each class can be used for numerical computations. The use of midpoints for actual values is based on the assumption that actual cover values are distributed symmetrically about the midpoint.

Plant height measurements are used to estimate the average height of individual species or species by size class. Plant heights give detailed information about the vertical distribution of plant species cover on the plot. In addition, height measurements allow the examiner to calculate plant species volume (cover x height) and to estimate biomass using the appropriate biomass equations based on cover and height. Plant height is measured with a yard stick (or meter stick) for small plants (<10 ft or 3 m) and with a clinometer for larger plants (>10 ft or 3 m).

There are many ways to streamline or customize the SC sampling method. The FIREMON three-tier sampling design can be employed to optimize sampling efficiency. See the sections on **User Specific SC Sampling Design** and **Sampling Design Customization** below.

SAMPLING PROCEDURE

This method assumes that the sampling strategy has already been selected and the macroplot has already been located. If this is not the case, then refer to the FIREMON **Integrated Sampling Strategy** and for further details.

The SC sampling procedure is presented in the order of the fields that need to be completed on the SC data form, so it is best to reference the SC data form when reading this section. The sampling procedure described here is the recommended procedure for this method. Later sections will describe how the FIREMON three-tier sampling design can be used to modify the recommended procedure to match resources, funding, and time constraints.

See **How To Locate a FIREMON Plot**, **How To Permanently Establish a FIREMON Plot** and **How to Define the Boundaries of a Macroplot** for more information on setting up your macroplot.

Preliminary Sampling Tasks

Before setting out for your field sampling, layout a practice area with easy access. Try and locate an area with the same species or vegetation life form you plan on sampling. Get familiar with the plot layout and the data that will be collected. This will give you a chance to assess the method and will help you think about problems that might be encountered in the field. For example, use the test plot as an opportunity to check sampler's cover estimates by applying the point intercept method on the same plot and comparing the two. It is better to answer these questions before the sampling begins so that you are not wasting time in the field. This will also let you see if there are any pieces of equipment that will need to be ordered.

Many preparations must be made before proceeding into the field for SC sampling. First, all equipment and supplies in the **SC Equipment List** must be purchased and packed for transport into the field. Since travel to FIREMON plots is usually by foot, it is important that supplies and equipment be placed in a comfortable daypack or backpack. It is also important that there be spares of each piece of equipment so that an entire day of sampling is not lost when something breaks. Spare equipment can be stored in the vehicle rather than the backpack. Be sure all equipment is well maintained and there are plenty of extra supplies such as plot forms, map cases, and pencils.

All SC Plot Forms should be copied onto waterproof paper because inclement weather can easily destroy valuable data recorded on standard copier paper. Plot forms should be transported into the field using a plastic, waterproof map protector or plastic bag. The day's sample forms should always be stored in a dry place (i.e., office or vehicle) and not be taken back into the field for the next day's sampling.

We recommend that one person on the field crew, preferably the crew boss, have a waterproof, lined field notebook for recording logistic and procedural problems encountered during

sampling. This helps with future remeasurements and future field campaigns. All comments and details not documented in the FIREMON sampling methods should be written in this notebook.

It is beneficial to have plot locations for several days of work in advance in case something happens, such as the road to one set of plots is washed out by flooding. Plots should be referenced on maps and aerial photos using pin-pricks or dots to make navigation easy for the crew and to provide a check of the georeferenced coordinates. We found that it is very easy to transpose UTM coordinate digits when recording georeferenced positions on the plot sheet, so marked maps can help identify any erroneous plot positions. If possible, the spatial coordinates should be provided if FIREMON plots were randomly located.

A field crew of two people is probably the most efficient for implementation of the SC sampling method. There should never be a one-person field crew for safety reasons, and any more than two people will probably result in some people waiting for critical tasks to be done and unnecessary trampling within the macroplot. The crew boss is responsible for all sampling logistics including the vehicle, plot directions, equipment, supplies, and safety. The crew boss should be the note taker and the technician should perform most cover and height measurements. However, the SC form can easily be completed by one person, so it may be best for the other crew member to fill out other data forms or perform other FIREMON tasks. The initial sampling tasks of the field crew should be assigned based on field experience, physical capacity, and sampling efficiency, but sampling tasks should be modified as the field crew gains experience. Tasks should also be shared to limit monotony.

Designing the SC Sampling Method

There is a set of general criteria recorded on the SC Plot form that forms the user-specified design of the SC sampling method. Each general SC field must be designed so that the sampling captures the information needed to successfully complete the management objective within time, money and personnel constraints. These general fields should be determined before the crews go into the field and should reflect a thoughtful analysis of the expected problems and challenges in the fire monitoring project.

Plot ID construction

A unique plot identifier must be entered on the CF data form. This is the same plot identifier used to describe general plot characteristics in the Plot Description or PD sampling method. See **How to Construct a Unique Plot Identifier** for details on constructing a unique plot identifier. Enter the plot identifier at the top of the SC data form.

Macroplot size

The typical macroplot sampled in the SC method is a 0.10 acre (0.04 ha) circular plot having a radius of 37.2 ft. (11.28 m). This plot size will be sufficient for most forest ecosystems and

should be used if no other information is available. It is more efficient to use the same macroplot shape and size for all the FIREMON sampling methods on the plot so if you are using other FIREMON sampling methods which require a baseline and transects then a rectangular plot of 66 ft. x 66 ft. (20 m x 20 m) should be used. For example, if the FIREMON DE method is being used to estimate density for some species, or if ocular cover is being calibrated using the FIREMON CF or LI methods, then use a rectangular macroplot. The macroplot radius or length and width are recorded in Fields 7 and 8 on the PD data form. See **How To Establish Plots with Multiple Methods** if you are sampling with more than one method.

Plant species ID level

This field is used to determine the sampling level intensity for the SC method. Enter the percent cover above which all plants are identified in Field 1 on the SC data form. For example, if you were interested in only sampling plants with at least 5 percent cover then the number 5 would be entered in Field 1. Entering a 0 (zero) in this field indicates that all plant species on the plot will be identified (i.e. a full species will be recorded). Since most changes in plant species cover occur in species that are already present on the plot, full species lists should be collected when feasible. Full species lists are especially useful if your data will be analyzed for biodiversity calculations, community classification, or species inventory. For example, since biodiversity calculations use the number of individual species as part of the calculation, it is important that each species be recorded.

Conducting the SC Sampling Tasks

Initial plot survey

Once the plot boundary is delineated (see **How to Define the Boundaries of a Macroplot)**, walk around the plot and become familiar with the plant species and vegetation layers. As you go, use Field 2 to record species and ground cover codes you identify. Only record the items that you are interested in sampling. For example, if you are only interested in monitoring the cover of noxious weeds you only have to record those species in Field 2.

FIREMON provides plant species codes from the NRCS Plants database. However, local or customized plant species codes are also allowed in FIREMON. See **How to Customize Plant Species Codes** for more details. Codes other than plant species codes may also be entered in this field. For example, users may enter codes for estimating cover of snags or downed wood on the plot. See the section on **User-specific SC sampling design** below for more details.

After examining the macroplot, return to the center and start to record cover and height for all appropriate plant species as described below.

Sampling cover

Starting with the first species on you list, enter the plant species status in Field 3 on the SC data form. Status describes the general health of the plant species as live or dead using the following codes:

> **L – Live:** plant with living tissue
> **D – Dead:** plant with no living tissue visible
> **NA – Not Applicable**

Plant status is purely qualitative but it does provide an adequate characteristic for stratification of pre-burn plant health and in determining post-burn survival.

Size class

Plant species size classes represent different layers in the canopy. For example, the upper canopy layer could be defined by large trees, while pole size trees and large shrubs might dominate the middle layer of the canopy, and the lower canopy layer could include seedlings, saplings, grasses and forbs. Size class data provide important structural information such as the vertical distribution of plant cover. Size classes for trees are typically defined by height for seedlings and diameter at breast height (DBH) for larger trees. Size classes for shrubs, grasses, and forbs are typically defined by height. If the vegetation being sampled has a layered canopy structure, then cover can be recorded by plant species and by size class. Total size class cover for a plant species can equal more than 100 percent due to overlap between different size classes.

FIREMON uses a size class stratification based on the ECODATA sampling methods (Jensen and others, 1994). Group individual plants by species into one or more tree size classes (table SC-1) or shrub, grass, and forb size classes (table SC-2). There can be multiple size classes for each plant species. See **How To Measure DBH** for detailed information on measuring DBH to group trees into size classes. See **How to Measure Plant Height** for detailed information on measuring height for grouping shrubs into size classes.

Table SC-1. Tree size class codes.

Tree Size Class Codes	Tree Size Class English	Tree Size Class Metric
TO	Total cover	Total cover
SE	Seedling (<1 in. DBH or <4.5 ft height)	Seedling (<2.5 cm DBH or <1.5 m height)
SA	Sapling (1.0 in. - < 5.0 in. DBH)	Sapling (2.5 - <12.5 cm DBH)
PT	Pole Tree (5.0 in. – <9.0 in. DBH)	Pole Tree (12.5 – <25 cm DBH)
MT	Medium Tree (9.0 in. – <21.0 in. DBH)	Medium Tree (25 – <50 cm DBH)
LT	Large Tree (21.0 in. – <33.0 in. DBH)	Large Tree (50 – <80 cm DBH)
VT	Very Large Tree (33.0+ in. DBH)	Very Large Tree (80+ cm DBH)
NA	Not Applicable	Not Applicable

Table SC-2. Shrub, grass, and forb size class codes.

Shrub / Herb Size Class Codes	Shrub / Herb Size Class English	Shrub / Herb Size Class Metric
TO	Total cover	Total cover
SM	Small (<0.5 ft height)	Small (<0.15 m height)
LW	Low (0.5 - <1.5 ft height)	Low (0.15 - <0.5m height)
MD	Medium (1.5 – <4.5 ft height)	Medium (0.5 – <1.5 m height)
TL	Tall (4.5 – <8 ft height)	Tall (1.5 – <2.5 m height)
VT	Very Tall (8+ ft height)	Very Tall (2.5+ m height)
NA	Not Applicable	Not Applicable

If you are recording cover by size class, enter the size class code for each plant species in Field 4 on the SC data form. If size class data is not recorded, then record only the total cover for each plant species. When recording total cover for a species, use the code "TO", for "total" Cover.

Estimating cover

Cover is the vertical projection of the foliage and supporting parts onto the ground (figure SC-1). See **How to Estimate Cover** for more details. When estimating total cover for a plant species, do not include overlap between canopy layers of the same plant species (figure SC-2). When estimating cover by size classes for a plant species, the cover for each size class is recorded and includes canopy overlap between different size classes (figure SC-3). Select one of the following cover class codes (table SC-3) to describe the cover estimate for the species. Enter the cover class code in Field 5 on the SC data form.

Table SC-3. Cover class codes.

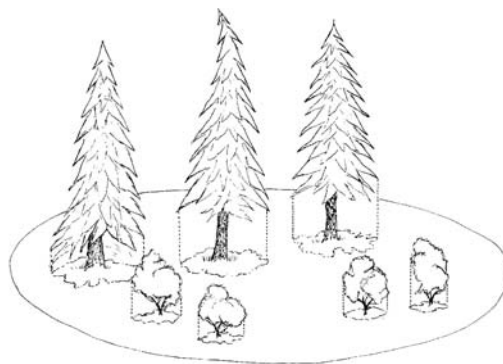| Code	Cover Class
0	Zero percent cover
0.5	>0-1 percent cover
3	>1-5 percent cover
10	>5-15 percent cover
20	>15-25 percent cover
30	>25-35 percent cover
40	>35-45 percent cover
50	>45-55 percent cover
60	>55-65 percent cover
70	>65-75 percent cover
80	>75-85 percent cover
90	>85-95 percent cover
98	>95-100 percent cover

Figure SC-1. Cover is estimated as the vertical projection of vegetation onto the ground.
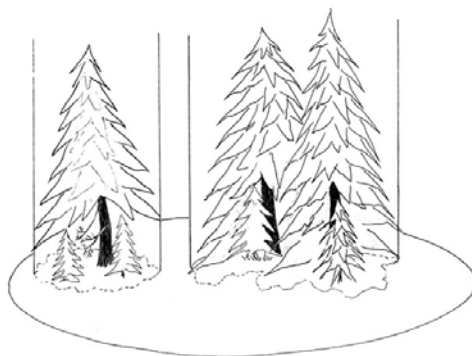

Figure SC-2. Estimating total cover for plant species with overlapping canopies. In this figure the small trees underneath the canopy of the larger trees are the same plant species. Cover is estimated as the projection of the large tree canopy onto the ground, which overlaps the canopy of the smaller trees.
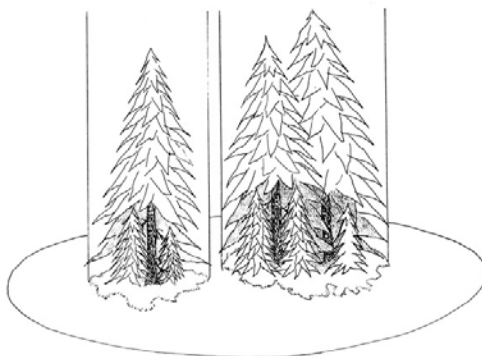
Figure SC-3. Estimating cover by size class for plant species. In this figure the small trees underneath the canopy of the larger trees are the same plant species but a different size class (e.g. seedlings and saplings). Cover is estimated separately for each size class.

Measuring average height

Measure the average height for each plant species in feet (meters) within +/- 10 percent of the mean plant height. If plant species are recorded by size class, measure the average height for a plant species by each size class. See **How to Measure Plant Height** for more details. Enter plant height in Field 6 of the SC data form.

Using the optional fields

There are two optional fields for user defined codes or measurements. For example, codes can be entered to record plant species phenology or wildlife utilization of plant species. If standing dead trees (snags) were recorded on the SC data form, one could enter a decay class code in one of the optional fields. Enter the user defined codes or measurements in Fields 7 and 8 on the SC data form.

Precision Standards

Use these precision standards for the SC sampling.

Table SC-4. Precision guidelines for SC sampling.

Component	Standard
Size class	+1 class
Cover	+1 class
Height	+10 percent average height

SAMPLING DESIGN CUSTOMIZATION

This section will present several ways that the SC sampling method can be modified to collect more detailed information or streamlined to collect only the most important tree characteristics. First, the suggested or recommended sample design is detailed, then modifications are presented.

Recommended SC Sampling Design

The recommended SC sampling design follows the Recommended FIREMON Sampling Strategy and is listed below:

Macroplot Size: 0.10 acre circular plot (0.04 hectare circular plot)

Collect plant species cover. Species ID level = "0"; record all species present in the plot.

Streamlined SC Sampling Design

The streamlined SC sampling design follows the Simple FIREMON sample strategy and is designed below:

Macroplot Size: 0.10 acre circular plot (0.04 hectare circular plot)

Collect plant species cover. Species ID level = "5"; record all species with 5 percent cover or greater in the plot.

Comprehensive SC Sampling Design

The comprehensive SC sampling design follows the Detailed FIREMON sampling strategy and is detailed below:

Macroplot Size: 0.10 acre circular plot (0.04 hectare circular plot)

Collect plant species cover and average height by size class. Species ID level = "0"; record all species present in the plot.

User-specific SC Sampling Design

There are several ways the user can adjust the SC sample fields to make sampling more efficient and meaningful for local situations. Use the species ID level (Field 1) to reduce the number of species recorded. Higher species ID levels yield smaller plant lists. For example, only plant species with 5 percent cover or greater are recorded with a species ID level of 5, while a species ID level of 10 limits the plant list to species with 10 percent cover or greater. Sampling a reduced species list can be accomplished in a very short time. The SC method can be even more selective by entering 99 in the species ID level, indicating that only specific plant species are being

recorded. For example, you might be interested in documenting the presence or absence of rare plants or the invasion of noxious weeds after a fire. In this case only the rare plants or noxious weeds are recorded.

Ocular estimates of cover can be recorded to the nearest 1 percent (i.e., 17 percent) instead of a cover class. This will allow values to be grouped into different cover classes later when conducting data analysis. Since not all examiners use the same cover classes, this allows the actual estimated cover values to be grouped into any cover class convention. Actual cover values are useful when monitoring changes in species with very low cover values. If cover changes from 3 to 6 percent, recording 6 percent cover is more accurate than recording 10 percent, the midpoint of the next cover class (5 to 15percent). However, it is doubtful that cover can be accurately estimated to a 1 percent level using the human eye. If actual cover values are recorded, or if different cover classes are used than the classes listed in the FIREMON SC methods, record the information in the Metadata table.

You can also make ocular estimates of cover for items other than just plant species. In addition, the optional fields give the user flexibility to record their own codes or measurements. Some examples of information recorded in the optional fields might be maturity and vigor for plant species, decay classes for snags, and wildlife utilization of plants.

Sampling Hints and Techniques

Examiners must be knowledgeable in plant identification.

It is relatively easy to learn to estimate cover to the nearest cover class. Examiners can calibrate their ocular estimates by periodically double sampling with the FIREMON Cover/Frequency (CF) or Point Intercept (PO) method for small shrubs, grasses, and forbs and the FIREMON Line Intercept (LI) method for large shrubs and trees. Even an experienced investigator may assign an item to the wrong cover. Calibration of ocular estimates should be conducted at the outset of inventory projects and occasionally (usually every 5 to 10 ocular macroplots) during the project. Variability of cover estimates between trained examiners is usually minimal and is negated by the large number of samples that can be obtained with this method.

Examiners can calibrate their eyes for estimating cover by using the various size cutouts, circular subplots, within the circular macroplot. They should also become familiar with all the subplot sizes and the percent of the entire macroplot each circular subplot represents. Samplers can then mentally grouped species into a subplot and use the subplot size to estimate percent cover. See **How to Estimate Cover** for more details.

Height can be difficult to measure for plant species or species by size class since the value must represent an average for all individual plants on the macroplot. One solution is to measure the height of a representative plant. Another solution, which requires more time, is to take additional measurements of individual plants and average the height values.

When entering data on the SC plot form, examiners might run out of space on the first page. The form was designed to print multiple copies and more plant species are recorded on the additional plot forms.